PBMR Briefing Presented to the US NRC

January 31, 2001

White Flint - Rockville, Maryland

Attachment 2

Meeting Objectives

- Provide Overview of Exelon's Involvement
- Provide Summary of PBMR Design and Potential Licensing Issues
- Provide Our Preliminary Ideas on Licensing Approach and Schedule
- Provide Our Near Term Goals
- Begin Dialogue to Reach Agreement on Process, Schedule and Resources

Presentation Agenda

• Introduction	Ward Sproat
• Project Overview	Ward Sproat
• Basics of Plant Design	Vijay Nilekani
• Key Technical Licensing Issues	Ward Sproat

Break (15minutes)

• Licensing Process Options	Kevin Borton
• Licensing Process Unique Issues	Jim Muntz
• Licensing Process Funding	Jim Muntz
• Proposed Path Forward Discussion	Exelon/NRC

Project Overview

- Exelon, BNFL, ESKOM and IDC funding basic design and Detailed Feasibility Study for 110MWe PBMR
- DFS to be completed by June 2001
- Decision to build prototype in late 2001
  - Dependent on Economics
  - Approval required from partners and RSA Government
- Nominal 3 years construction / 1 year startup testing

Exelon Interests

- Own rights to 12.5% of PBMR Pty. Ltd.
  - Other funders: ESKOM (40%), IDC (25%), BNFL (22 1/2%)
- Main Interest: Source of Low Cost Power
- Merchant Nuclear Power

Exelon Generation Involvement

- 6 person team / 1 in RSA
- 1 seat on Board of PBMR Pty.
- Chairing Technical Subcommittee of Board
- Approach to project: Education, Assessment, Intervention
- Exelon Nuclear role is limited
  - Maintaining focus on safe plant operation

Pebble Bed Modular Reactor

Plant Design Overview

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Plant Design Fundamentals

- High Temperature Helium Cooled Reactor
- TRISO Coated Particle Fuel (Ceramic)
- Spherical Fuel Elements (as per German reactors)
- Direct Cycle Gas Turbine (Modified Brayton with Recuperation)
- Passive Safety Design
  - Fuel integrity maintained under most severe postulated (DBE) accident, with no early operator intervention required

Plant Specification

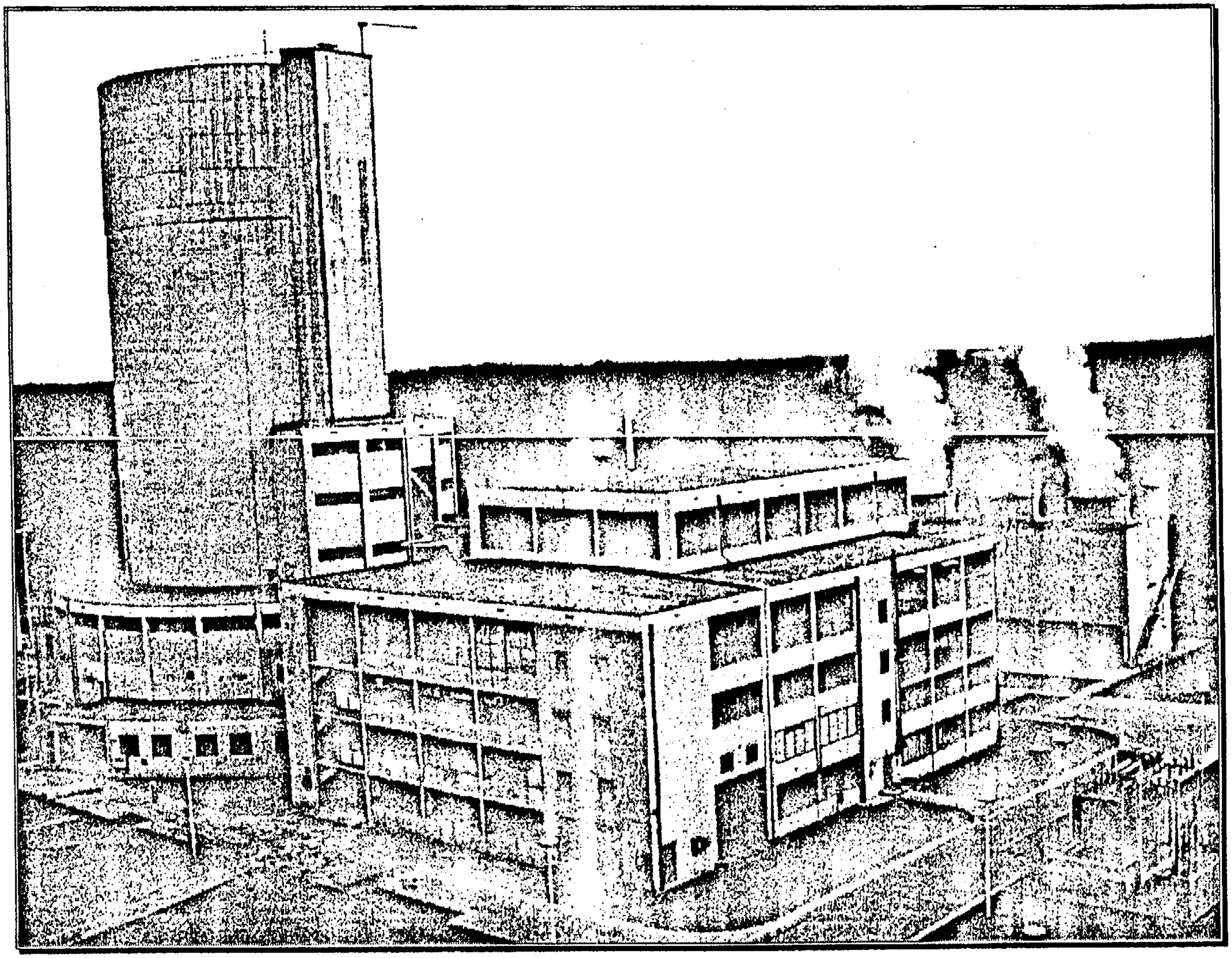
(Nominal)

• Rated power	100-115 MWe
• Continuous stable power range	0-100%
• Load Rejection w/o trip	100%
• Construction Schedule	24 months
• Planned Outages	30 days every 6 years
• Emergency Planning Zone	400 meters
• Plant Operating Life Time	40 years
• Spent Fuel Storage Capability (On Site) life generation	100 % of cycle

AVR: Jülich

(Operated 1967-88)

15MW Research Reactor

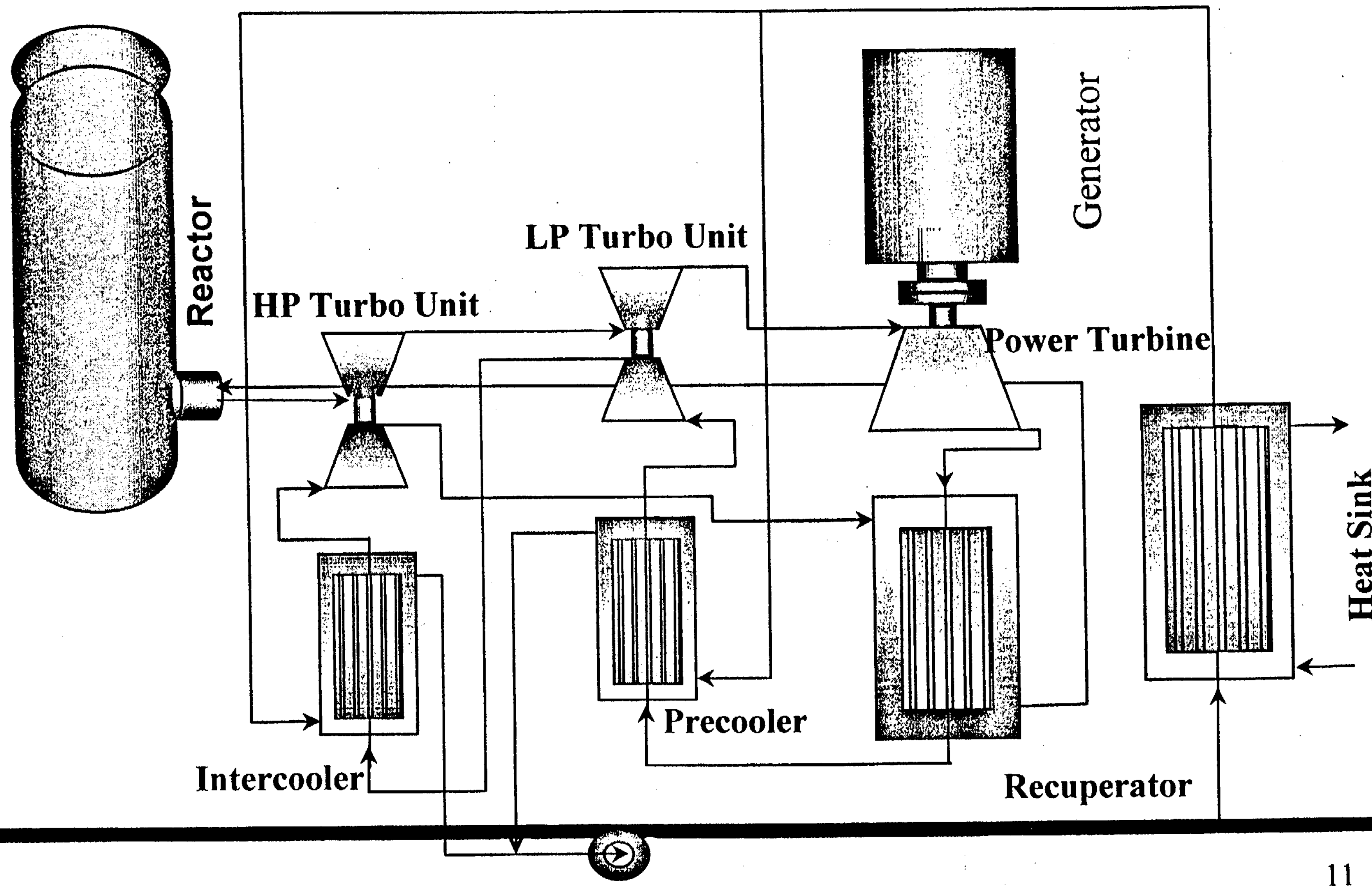


THTR: Hamm-Uentrop

(Operated 1985-89)

300MW Demonstration Reactor

PBMR Thermal Cycle



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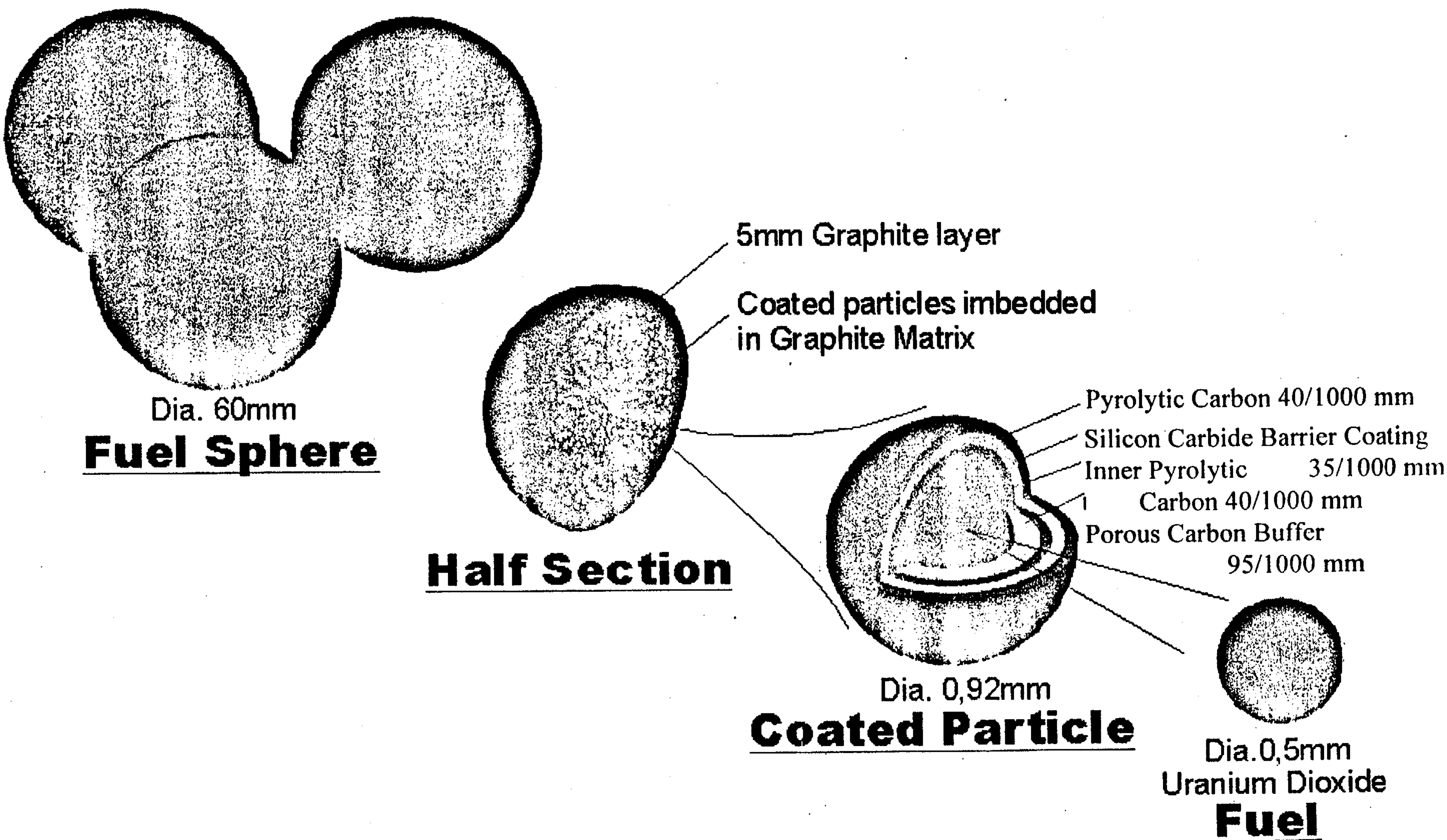
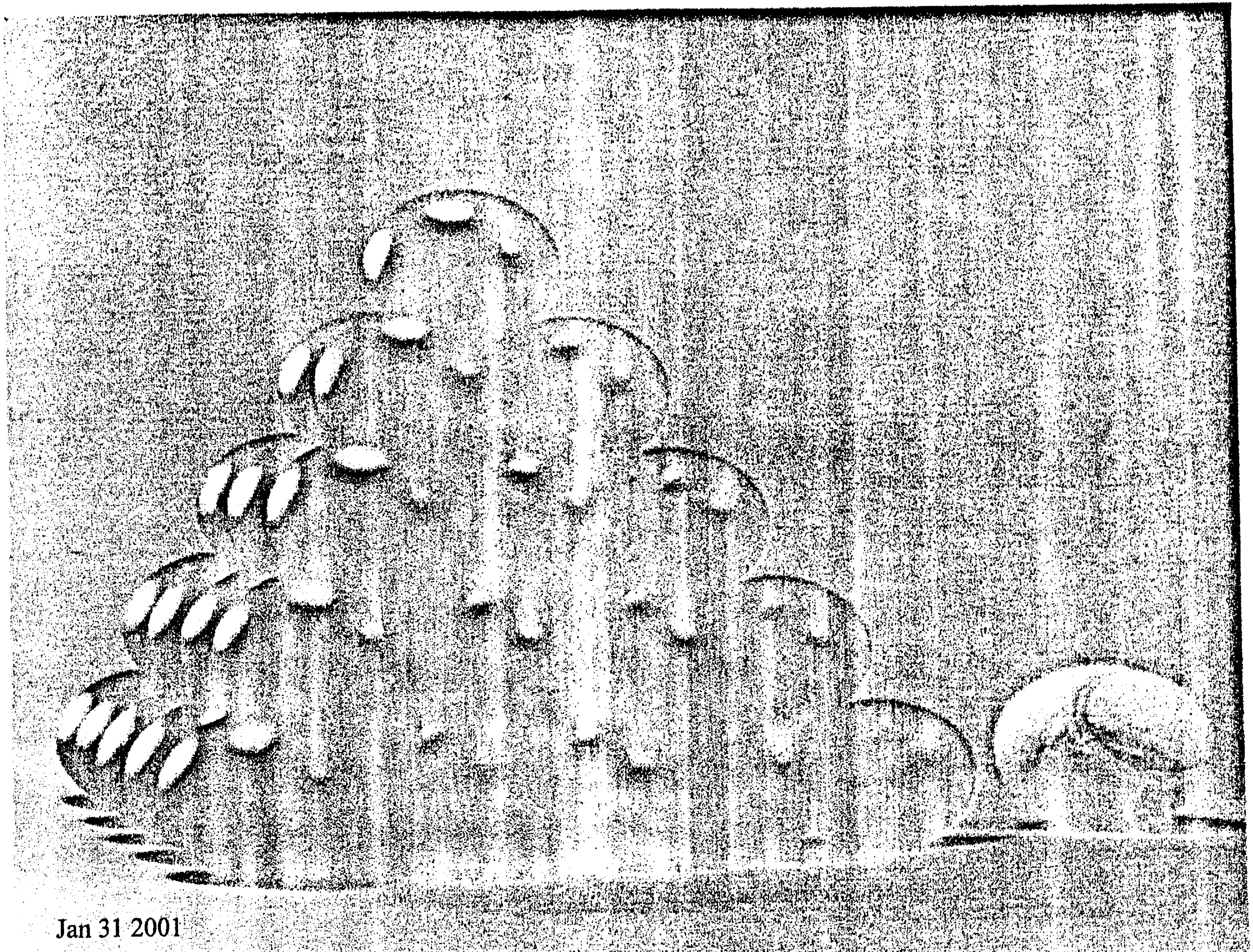
FUEL ELEMENT DESIGN FOR PBMR





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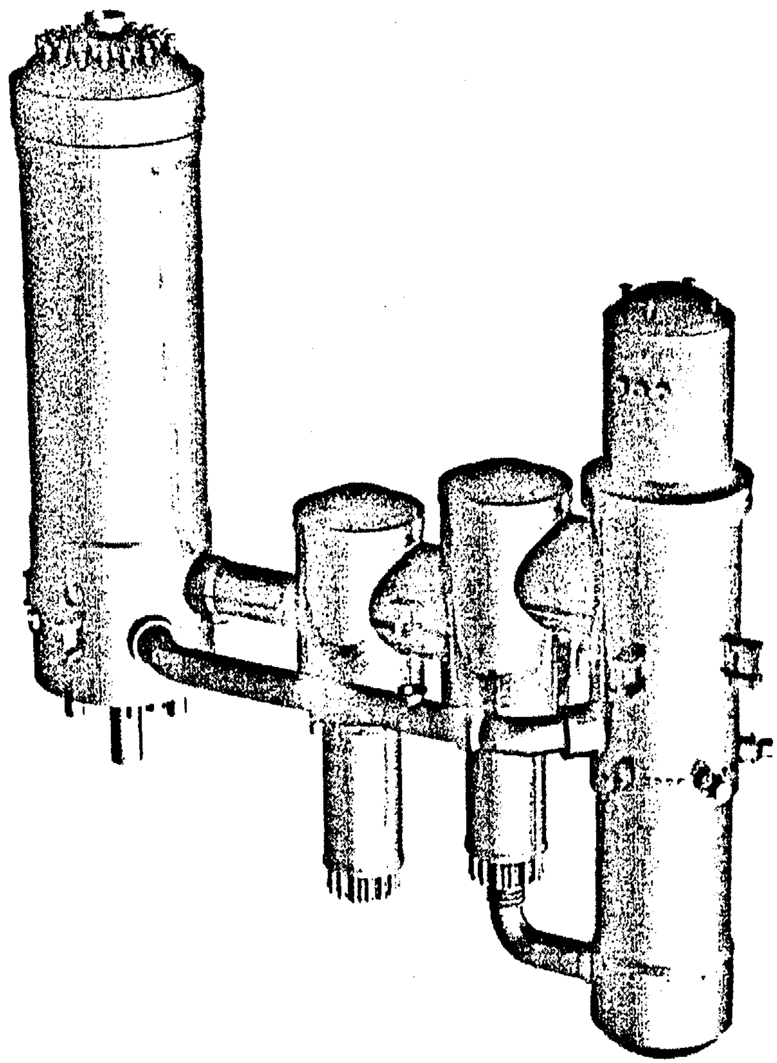
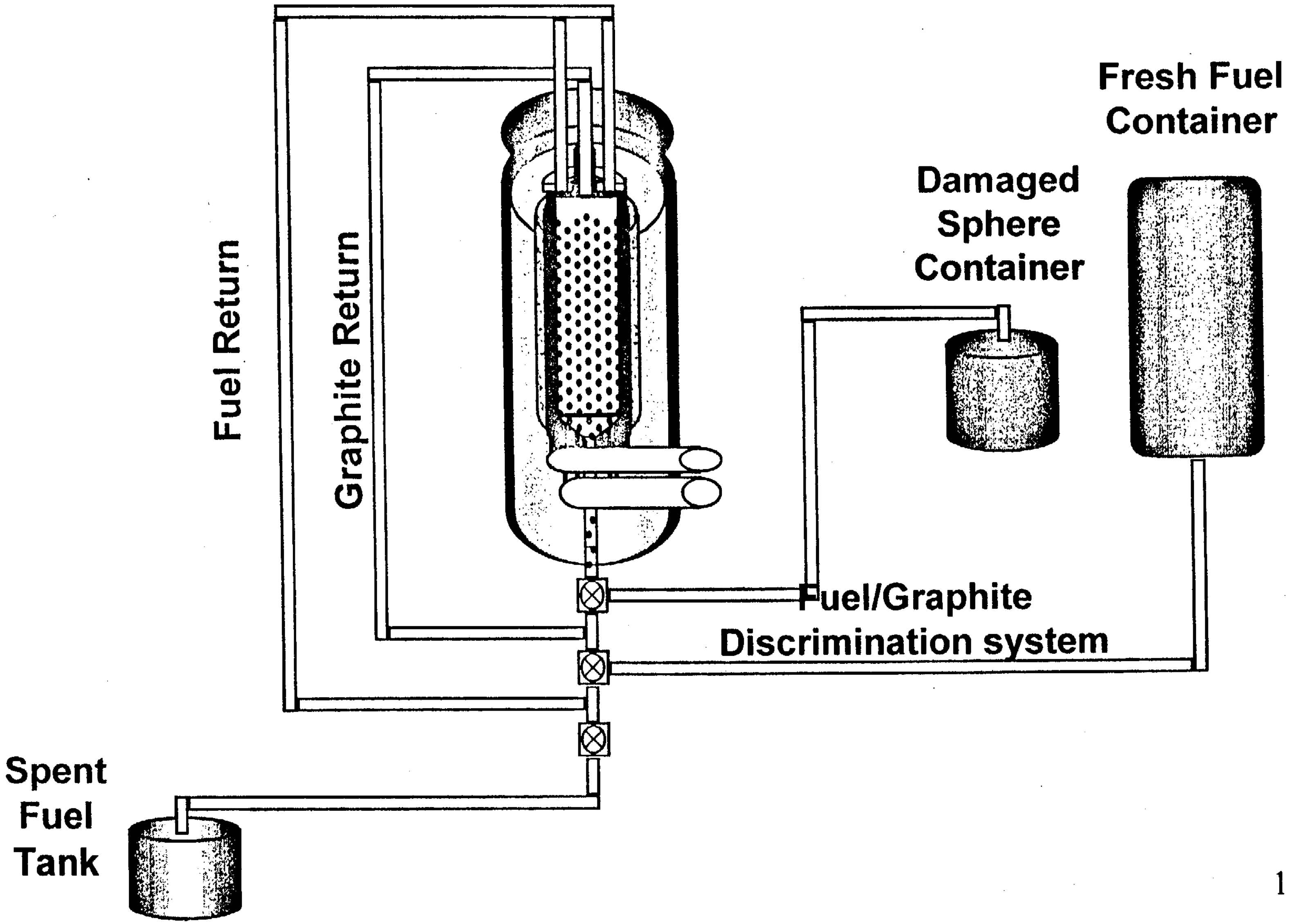
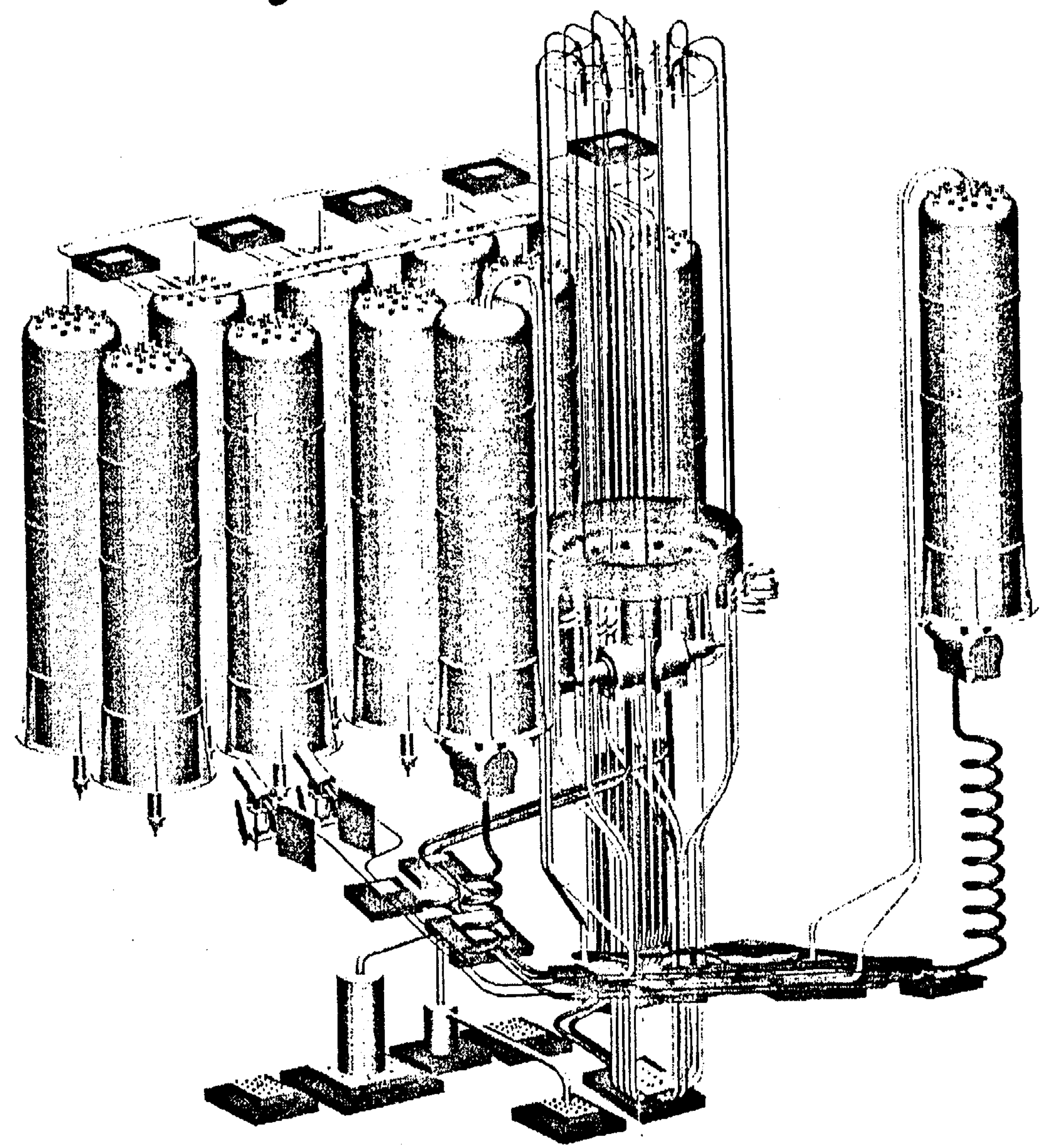
Main Power System



Fuel Handling & Storage System



Fuel Handling & Storage System



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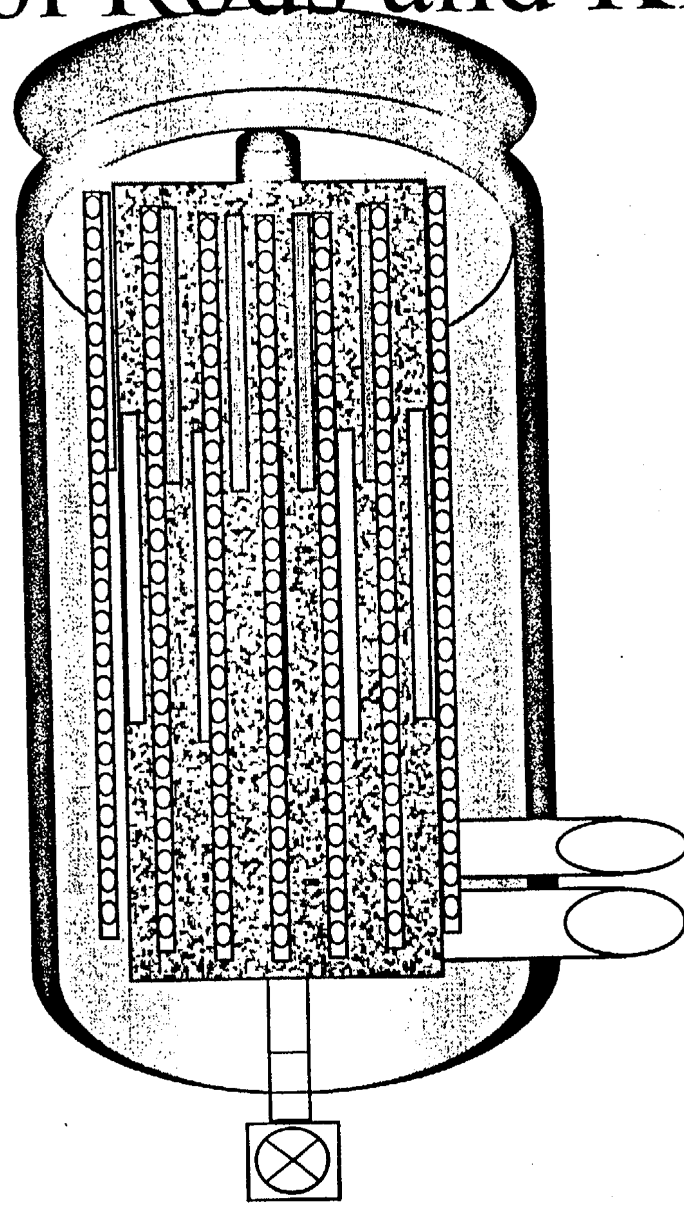
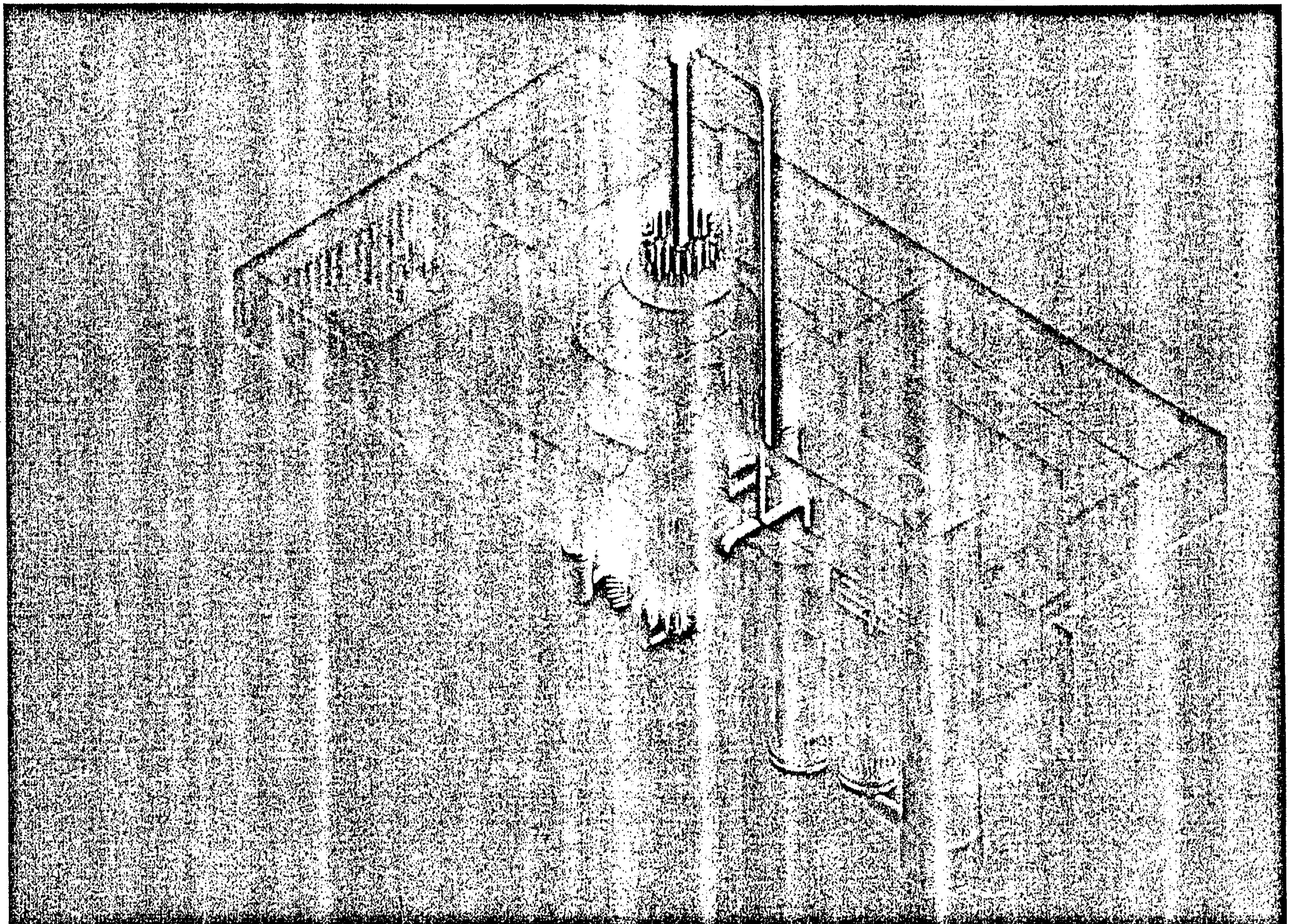
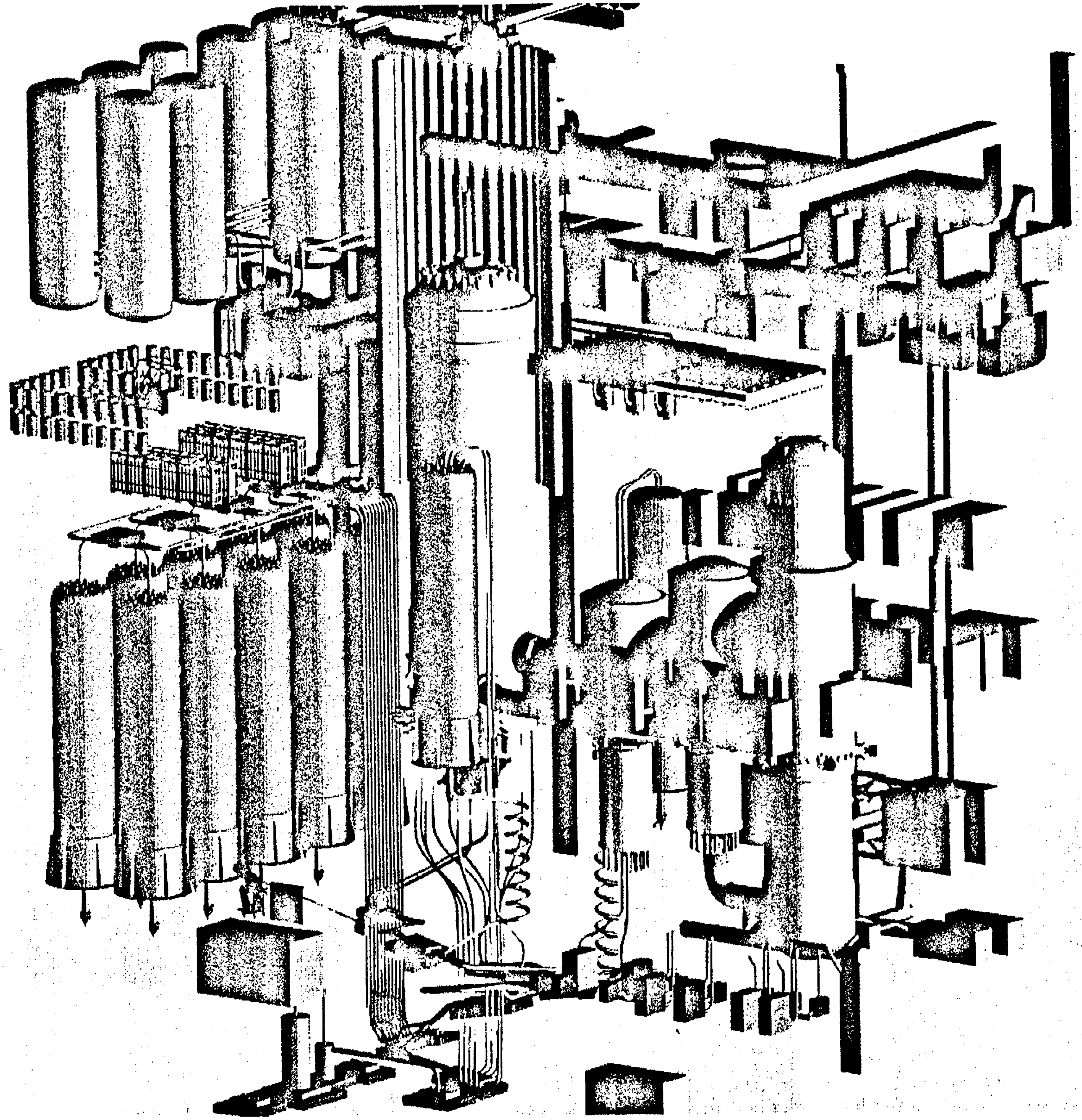
Control Rods and Klaks



Citadel/Building Design





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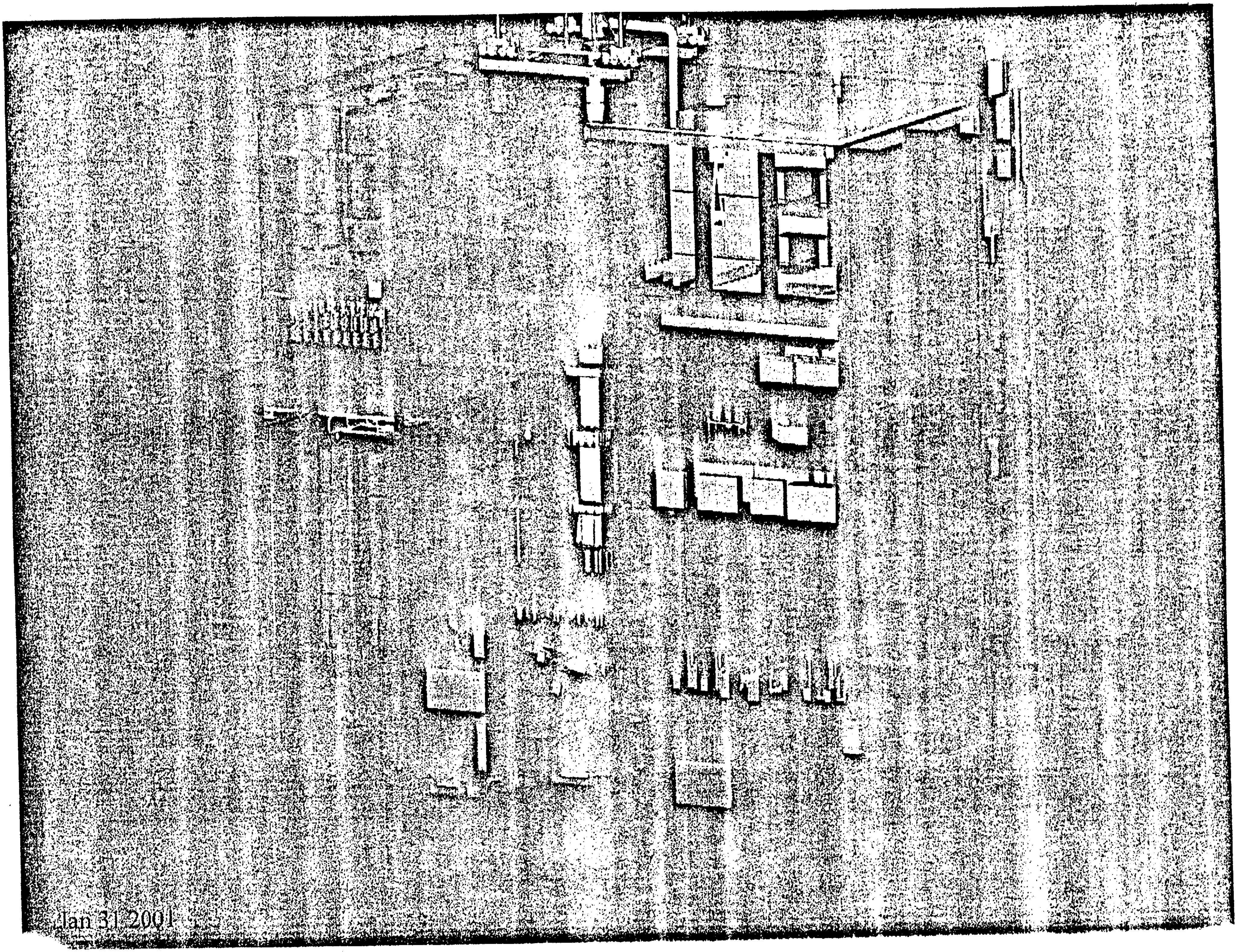
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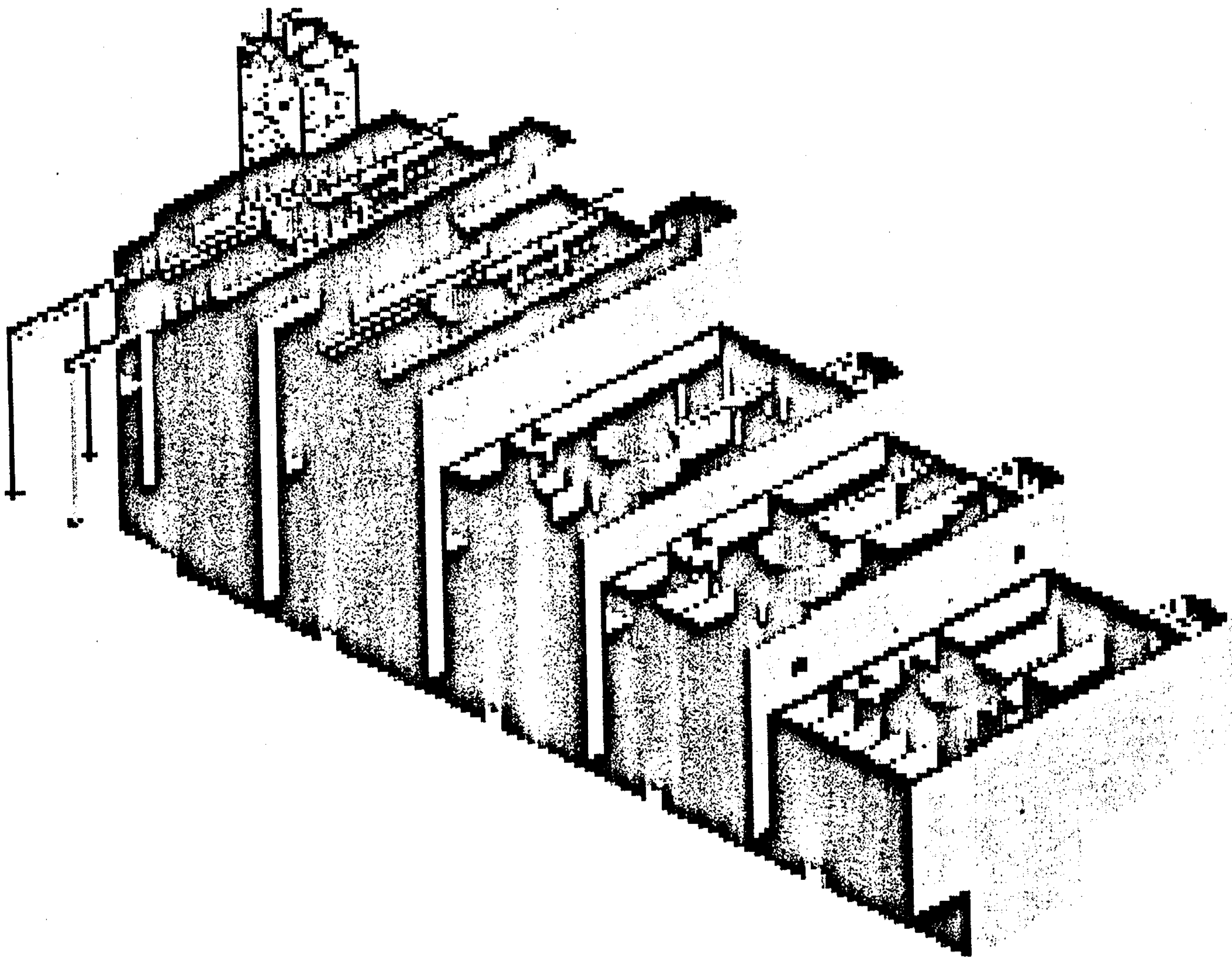
5 Module Construction



Pebble Bed Modular Reactor

Safety Discussion

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Key Paradigms

- The safety of the reactor core is not dependant on the presence of the coolant
- Early insertion of control rods or klaks is not a mandatory requirement in any accident scenario
- There is no inherent mechanism for runaway reactivity excursions or rapid power transients

PBMR: Safety Features

- Graphite used as Fuel sphere matrix and for core structural material
- Large thermal capacity ensures slow temperature transient behavior
- Very low power density – (order of magnitude below LWR's, ~ 15 to 30 times)
- Helium is a single phase coolant and chemically & radiologically inert.

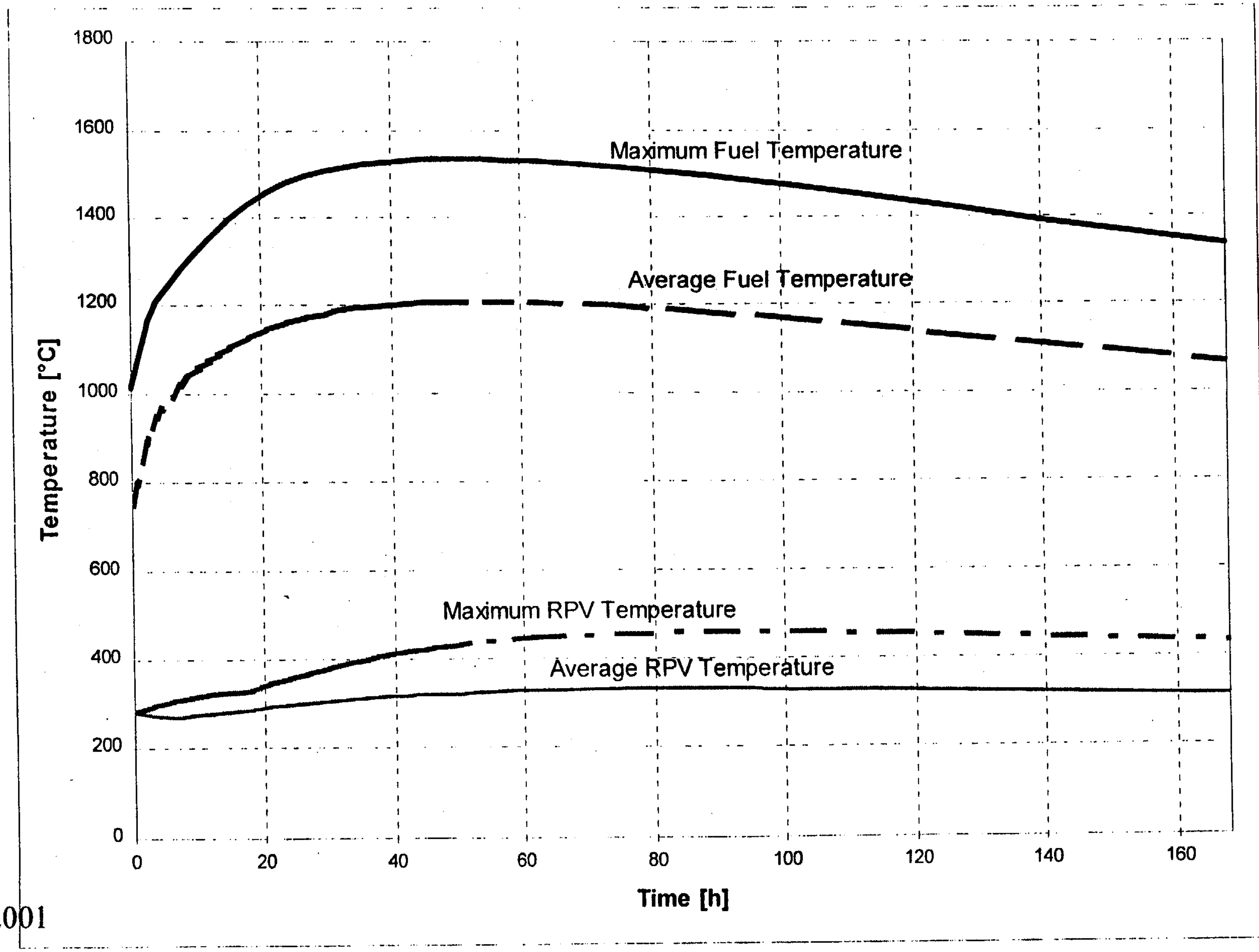
PBMR: Safety Features
(Continued)

- TRISO coating of UO_2 particles ensures low levels of contamination in primary circuit
- Strong negative temperature coefficient
- Plant design features severely mitigate air and water ingress
- Low excess reactivity possible in continuously fueled pebble bed

Design Basis Events
Categories and Mitigators

- Reactivity Excursions
  - Negative temperature Coefficient
- External Events (Aircraft Crash, Seismic)
  - Citadel/Building Design
- Core Damage
  - Low Power Level
  - Large Surface Area
  - Fuel Design Features

DLOFC Event – 268 MWt PBMR



Dose at Site Boundary

Most severe case event scenario

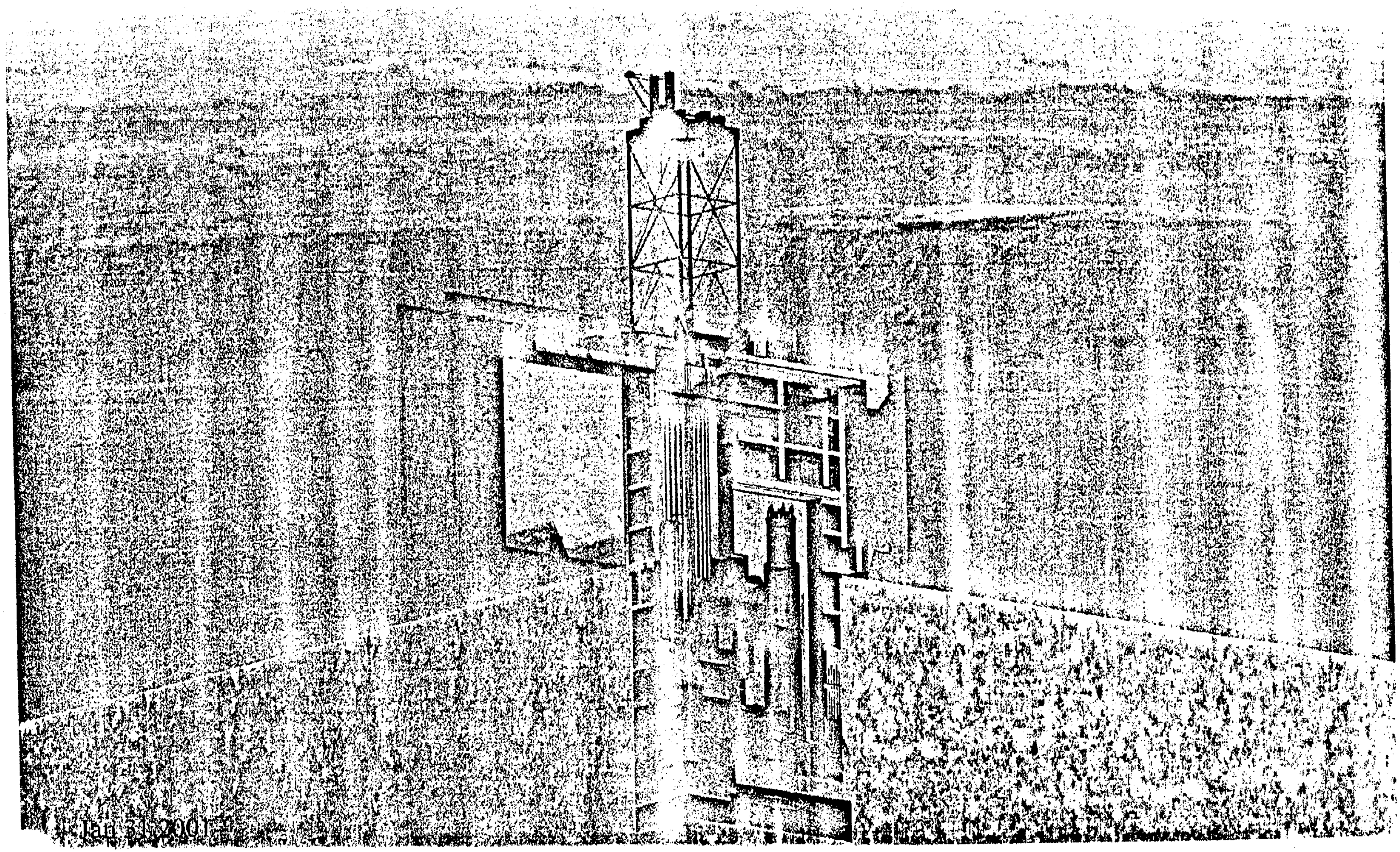
Expected dose 5.75 mR (57.48e-3 mSv)
(Preliminary)

Annual nominal background dose ~ 200 mR
(2 mSv)

(Cornwall is ~ 800 mR {8 mSv})

Protective Action Guideline 1000 mR (Whole Body)
5000 mR (Thyroid)

(100mR = 1mSv)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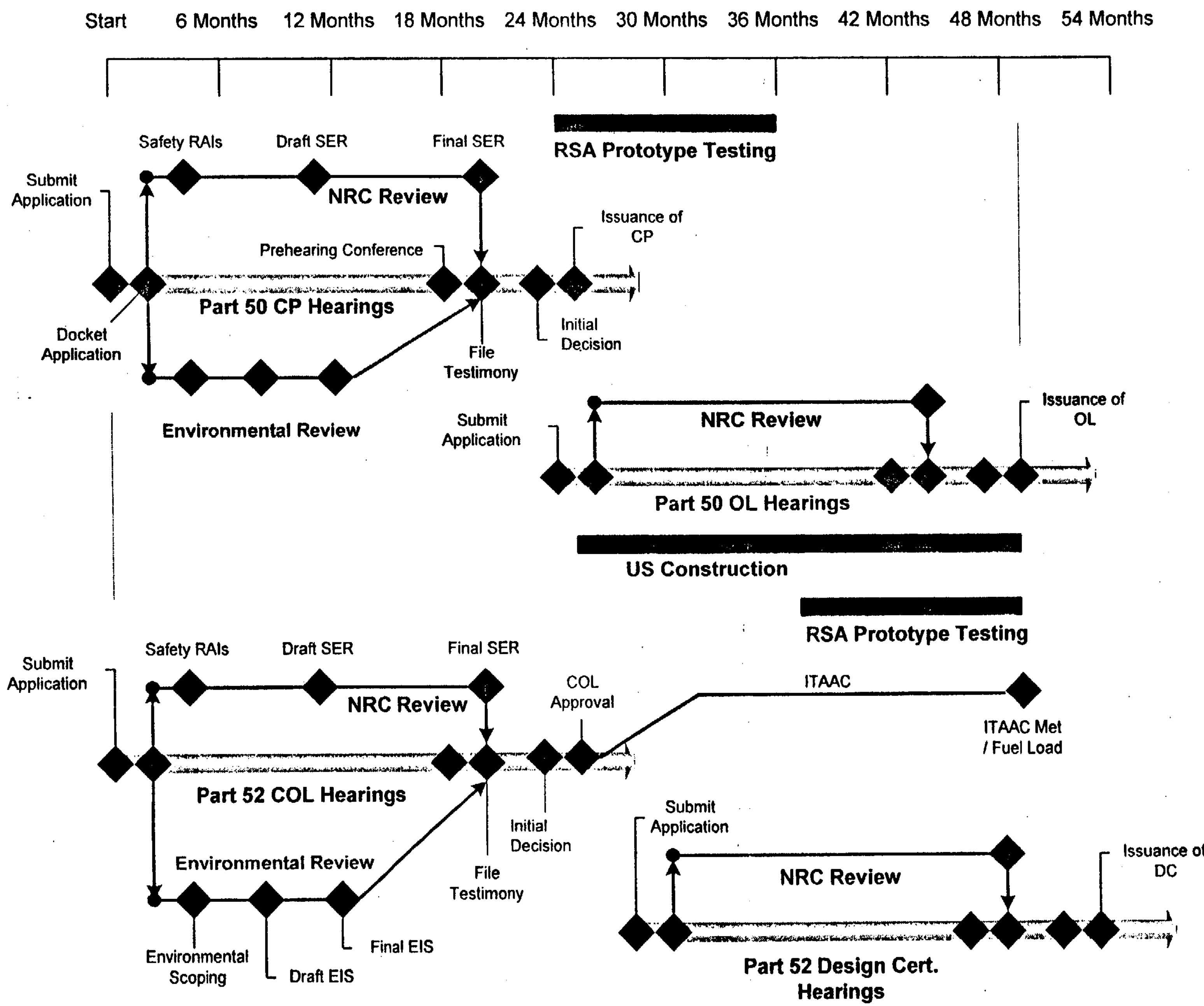
Key Technical Licensing Issues

- Fuel Qualification and Fabrication Process Licensing (South African Fuel)
- Source Term: Mechanistic or Deterministic
- Leak-Tight or Vented Containment
- Reduced Exclusion and EP Zones
- Materials Qualification
- Code V&V
- PRA - Uncertainties, Initiators and End States
- Regulatory Treatment of Non-Safety Systems
- Classification of SSC's

Licensing Process Options

- Two Step: Part 50 Construction Permit (CP) followed by Part 50 Operating License (OL)
- Part 52 Combined Construction and Operating License (COL)
- Part 52 Design Certification (DC)
- Siting Permit
  - Conventional and Early Siting Permit (ESP) Combined with Part 52

Current Licensing Process Components



Positive Process Attributes

- Part 52 COL
  - Provides more predictable schedule through start-up
  - Limits financial risks
  - Better fit for prototype testing and eventual design certification
- Part 50 CP
  - Does not require complete final design, therefore, shortens time to construction

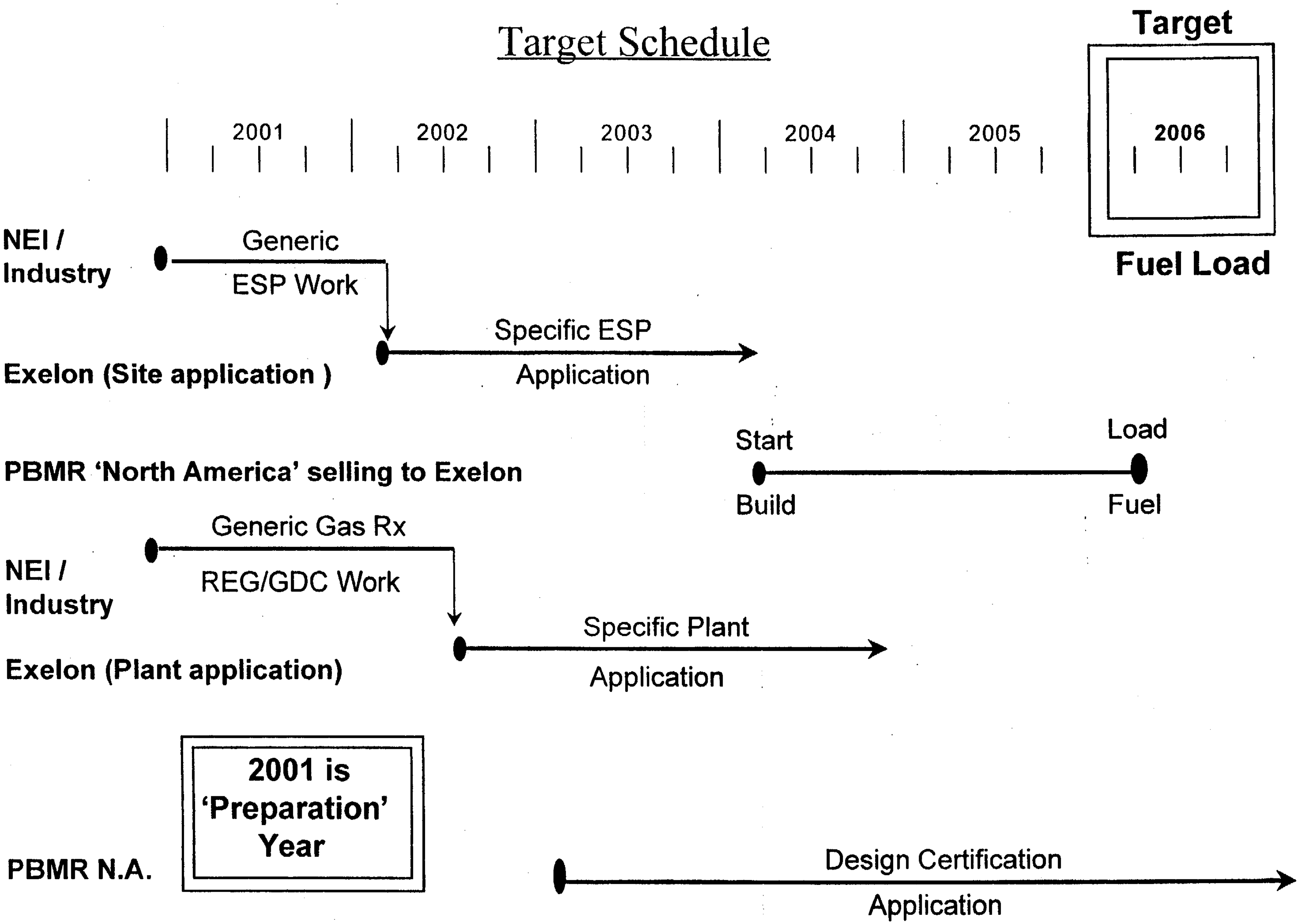
Current Thinking on US PBMR Licensing Approach

- Apply for ESP for Multiple Reactors Prior to Plant License Application (Exelon)
- Apply for Part 52 Multi-Reactor COL (Exelon)
- Utilize RSA Prototype Test Results
- Part 52 Design Certification Following Successful Completion of RSA Project and Operation of First US Reactor (PBMR Company)

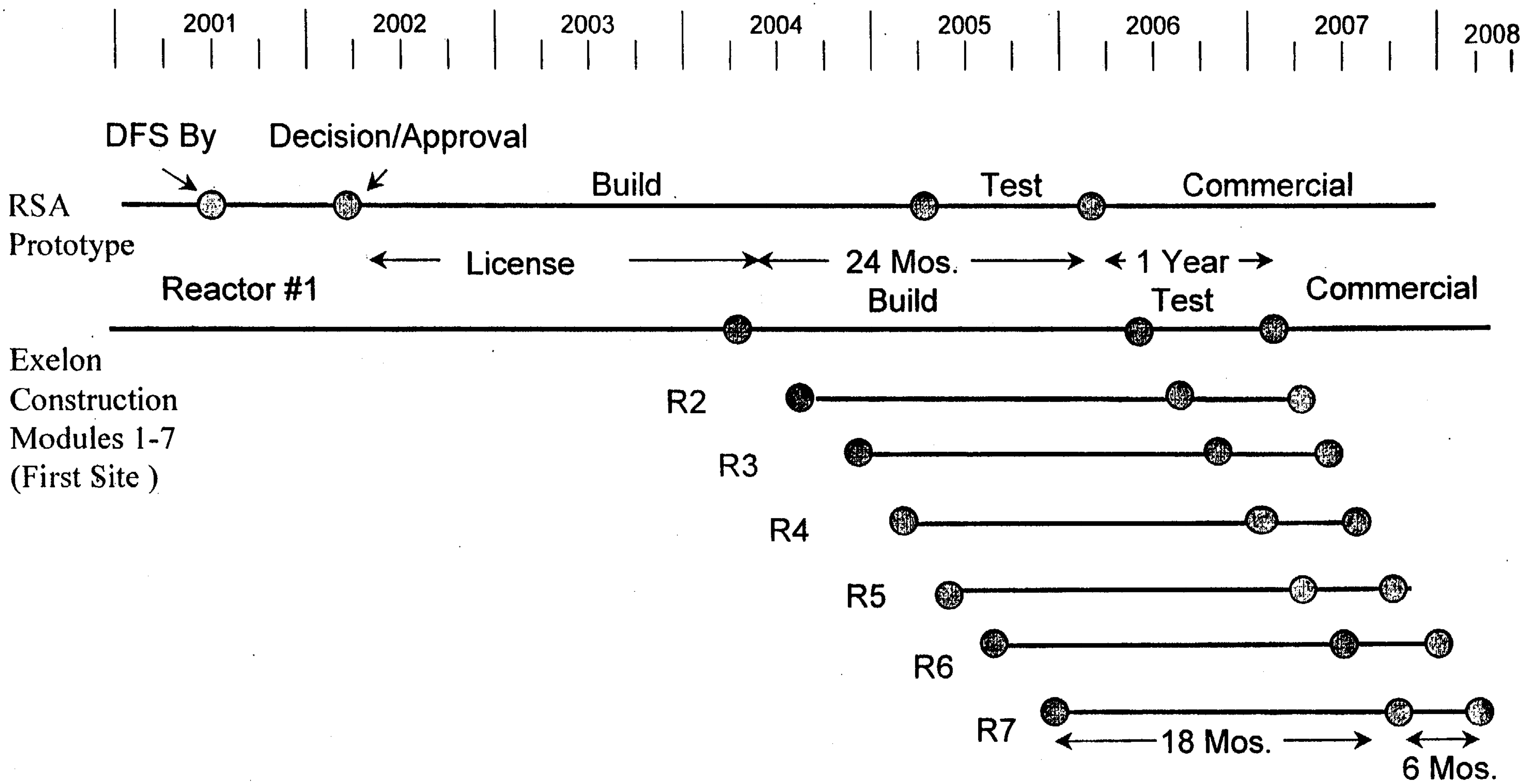
Licensing Process Unique Issues

- Merchant Nuclear Power/Deregulated Environment
- Multiple Reactors per Site and docket; Price Anderson and other implications
- Multi-national consortium
- 'Boeing Model' for PBMR sales
- Not a research project - a full-scale prototype being built
- Fuel cycle implications from fabrication to ultimate storage
- Efficient process for resolution of unresolved items, as evidenced in several recent initiatives, will be required
- Use of Part 52 ESP and a non-certified design
- Inherent Safety & Simplicity of design could shorten the process

Target Schedule



Overall Target Schedule Perspective



Licensing Process Funding

- Funding discussions are underway concerning fuel testing, training, NRC expertise development, and NRC fees
- Government funding for certain work on this advanced reactor/'first of a kind' technology
- NRC budget and resource constraints, timeframes, and competing priorities must be addressed

Next Steps

- Establish a Working Group to Develop HTGR Regulatory Framework
  - Establish the Key HTGR Design Elements Critical to Meeting NRC Safety and Regulatory Objectives
  - Identify Current Licensing Criteria that are Applicable to HTGR Designs
  - Identify any Additional Licensing Criteria which Uniquely Apply to HTGR Designs
- Establish an NRC PBMR Project Manager
  - Determine Appropriate PBMR Licensing Process and Schedule
- Develop Plan to Provide Gas Reactor Technology Education to NRC Staff

Near Term Goals

- Conceptual NRC Fees, Staffing, and Schedule Estimate by March 2001
- Preliminary HTGR Regulatory Framework by May 2001
- Identification of Necessary HTGR Policy / Regulation Changes and Schedule by September 2001
- By September 2001:
  - Reach Agreement on the PBMR Licensing Process
  - NRC PBMR Project Schedule and Budget Estimate
  - Identify PBMR-Applicable Regulations and any Additional Specific Requirements
- Establish HTGR Regulatory Framework/Policy by July 2002
- Others Identified Today

Open Discussion

Meeting Objectives Review

- Provide Overview of Exelon's Involvement
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